

**TAXONOMY AND BIOLOGY OF *LEMA*  
*TRIVITTATA* SAY, A VALID SPECIES WITH NOTES  
ON *L. TRILINEATA* (OLIV.)  
(COLEOPTERA: CHRYSOMELIDAE)<sup>1</sup>**

Richard E. White<sup>2</sup>, William H. Day<sup>1</sup>

**ABSTRACT:** Although *Lema trivittata* Say has generally been treated as a subspecies of *L. trilineata* (Oliv.), it is a valid species. Data included are: a complete synonymy with a description, a diagnosis covering points of difference between *L. trivittata* and *L. trilineata* with a table summarizing the differences, distribution, biology, and collection notes. There are illustrations of *L. trivittata* and its nearest relative *L. trilineata*.

Most publications since Schaeffer (1933) have followed him in treating *Lema trivittata* Say as a subspecies of *Lema trilineata* (Olivier), the threelined potato beetle. The minor external differences between the two species and the incomplete distribution data available to Schaeffer doubtless contributed to his erroneous conclusion.

Biological investigations by the junior author have established that *L. trivittata*, which feeds primarily on *Datura*, is a valid species distinct from *L. trilineata trilineata*, which feeds primarily on *Solanum* and *Physalis*. Cross matings of the 2 species show that they do not interbreed successfully. The morphological characters, plant hosts, and similar distributions reinforce the findings of the breeding experiments. The biological data are confirmed by studies done by B.J. Landis in Columbus, Ohio years ago (H.S. Barber notes) and C.H. Bare in Michigan (personal communication).

Following is a resume of our knowledge of *Lema trivittata*. This includes synonymy (with complete references), a description, a diagnosis, distribution, and biology. Because *L.t. trilineata* is the nearest relative of *L. trivittata*, the diagnosis presents the characters that distinguish the two. Reference is also made to *L.t. trilineata* in the distribution and biology sections.

---

<sup>1</sup>Received November 8, 1978.

<sup>2</sup>Systematic Entomology Laboratory, IIBIII, Agricultural Research, Sci. & Educ. Admin., USDA, c/o National Museum of Natural History, Washington, D.C., 20560.

<sup>1</sup>Beneficial Insects Research Laboratory, Sci. & Educ. Admin. USDA; 501 So. Chapel St., Newark, Delaware, 19713.

## Synonymy and description

### *Lema trivittata* Say, NEW STATUS

(Fig. 5)

- Lema trivittata* Say, 1824:429; Lacordaire, 1845: 421, 545; Emmons, 1854: 134; Jacoby, 1880: 6; Jacoby & Clavareau, 1904: 15; Clavareau, 1913: 81; Leng, 1920: 287; Schaeffer, 1933: 301 (lapsus, *trilineata* intended); Blackwelder, 1946: 632; Monros, 1960: 208; Kogan & Goeden, 1970: 529.
- Crioceris trivittata*, Harris, 1833: 580.
- Lema trilineata* ssp. *trivittata* Say, Schaeffer, 1933: 302-3; Knowlton & Smith, 1935: 242; Brimley, 1938: 221; Blackwelder, 1939: 61; Löding, 1945: 126; Fattig, 1948: 6; Balsbaugh & Hays, 1972: 21.
- Lema immaculicollis* Chevrolat, 1835: 112; Lacordaire, 1845: 419; Jacoby, 1880: 6; Jacoby & Clavareau, 1904: 15; Clavareau, 1913: 81; Leng, 1920: 287; Schaeffer, 1933: 302; Blackwelder, 1939: 61; Blackwelder, 1946: 632; Monros, 1960: 208; Kogan & Goeden, 1970: 529.
- Lema trivirgata* LeConte, 1859: 22 (junior homonym; not Lacordaire); Clark, 1866: 31; Crotch, 1873: 94; Jacoby, 1880: 6; Jacoby & Clavareau, 1904: 15; Snow, 1907a: 56; Snow, 1907b: 180; Cockerell & Fall, 1907: 194; Clavareau, 1913: 81; Leng, 1920: 287; Schaeffer, 1933: 302; Blackwelder, 1939: 61; Blackwelder, 1946: 632; Monros, 1960: 208; Kogan & Goeden, 1970: 529.
- Lema lecontei* Clark, 1866: 31 (replacement for *trivirgata* LeConte); Jacoby, 1880: 6; Jacoby & Clavareau, 1904: 15; Clavareau, 1913: 81; Leng, 1920: 287; Blackwelder, 1946: 632; Monros, 1960: 208; Puttler, 1966: 475; Kogan & Goeden, 1970: 529.
- Lema nigrovittata* Schaeffer (misidentification, not Guérin), 1933: 302; Blackwelder, 1939: 61; Monros, 1960: 208.

**General.** — Body length (anterior margin of pronotum to elytral apex) nearly 2 times as great as width; head 0.9 times as wide as pronotum; pronotum from 0.57 to nearly 0.60 times as wide as elytra. Body mostly yellow orange, sometimes dull orange or dull yellow, dark markings black.

**Head.** — Yellow orange to dull orange; vertex sometimes with a pair of black spots, one each side of middle, spots sometimes expanded posteriorly, may join, in which case base of head then black from sides to vertex; frons infrequently with a single black spot at middle, sometimes also with black along dorso-anterior margin of each eye and on labrum and clypeus. Sparse, yellowish pubescence around eyes, on genae, front of vertex, frons, clypeus, and labrum. Frontal lines forming an X, upper arms of X deeper into surface, wider than lower arms. Vertex anteriorly usually with a shallow, longitudinal groove, behind groove with a small fovea, groove sometimes joining fovea. Surfaces, except for most of vertex, more or less coarsely punctate. Antennae attaining humerus, over 0.6 times as long as an elytron; 1st 2 segments smooth, shining, remaining segments punctate, not shiny; 1st segment dull yellow to dull orange, 2nd segment usually predominantly pale, remainder dark, 3rd and 4th segments dark, sometimes pale beneath, remaining segments black. Last segment of maxillary palpus about 2 times as long as wide, widest just before base, tapering apically, tip blunt; last segment of labial palpus similar in form but a little wider.

**Pronotum.** — Dull yellow to dull orange, often with a black spot each side before middle, spots variable in size, distance separating spots varying from 7 times maximum diameter of a spot to equal to maximum diameter. Slightly wider than long; distinctly, broadly constricted at middle; with a small, distinct fovea at middle before base, joining a fine, arcuate, transverse

line, a 2nd, similar line between fovea and base; with coarse, not dense punctures between constriction and anterior margin, also along midline to fovea.

Elytra. — Dull light yellow to orange, usually yellow-orange, each elytron with black (rarely dark brown) on sutural interval; with black stripe (rarely dark brown) on 7th, 8th, and 9th intervals as in Fig. 5; elytron with 10 distinct rows of punctures, punctures much smaller in elytral apex; rows 6-9 abbreviated near humerus; each interval bearing a row of minute punctures, these smaller toward elytral apex.

Ventral surface. — Most of ventral surface and legs dull yellow to dull orange; side of mesosternum and metepisternum black, at maximum development of black markings with much of side of mesosternum, and much of coxae black, sometimes with black on apex of 1st abdominal segment, rarely also with black on metasternum. Legs dull yellow to dull orange, tibial apices dark brown to black, tarsi dark brown to black; often with femoral apices more or less darkened. Prosternum with fine, arcuate, transverse lines; mesosternum with moderate-sized, not dense punctation; metasternal punctation fine, most dense anteriorly at side, nearly absent at middle; abdominal punctation fine, most dense at sides, sparse at middle of each segment.

Length. — 5.1-7.3 mm.

Most of Say's original description of *Lema trivittata* describes *L. t. trilineata* as well as it does *L. trivittata*; however, there is mention of the tibiae being black at the tip. This is a very strong indication that Say's name is here correctly applied, for in *L. trivittata* the tibiae are predominantly light and black only apically; in *L.t. trilineata* the tibiae are nearly always predominantly black. There is no type for *L. trivittata*, because almost all of the Thomas Say collection is lost. The senior author plans revisionary work on N. American Criocerinae, and therein will select a neotype.

The past erroneous placement of *Lema trivittata* as a subspecies of *Lema trilineata* casts doubt on the identity of beetles identified in various papers simply as *Lema trilineata*. One such study is that by Force, 1966. In this paper the chief host plants of the beetle studied were given as species of *Datura*. Since both *Lema trivittata* and *L. trilineata daturaphila* Kogan and Goeden occur in California, either could have been the object of the study, though it is likely that the latter was.

#### Diagnosis

When alive, adults of *L. trivittata* and *L.t. trilineata* are separable by color characters. *Lema trivittata* has the head and pronotum yellow orange and the median yellow stripe of an elytron has white borders. Live specimens of *L.t. trilineata* have the head and pronotum orange, and the median yellow stripe of an elytron is not bordered by white, and may be yellow orange; infrequently the yellow stripe is reduced by the expanded black stripes on each side. Also, the eggs of *L. trivittata* are yellow and are covered by a sticky dark substance thickest at the polar ends. The eggs thus are dirty yellow with the ends nearly black. The eggs of *L.t. trilineata* are all yellow and have little sticky coating.

The color differences of living adults fade upon death. However, other

color differences persist, and these are summarized on Table 1. These differences are presented in the order of their diagnostic value, with the first 2 characters being the most useful in separating the 2 species. The first character also serves to distinguish *L. trivittata* from *L.t. daturaphila*, which occurs in southern California. Color characters and male genitalia (examined by the senior author) show that *L.t. daturaphila* is correctly placed as a subspecies of *L. trilineata*.

The male genitalia of *L. trivittata* and *L.t. trilineata* show differences in degree of chitinization of the internal sac armature. Note the greater darkness of these parts, especially in lateral view, in the cleared genitalia of *L. trivittata* (Fig. 1, 2) as compared with that of *L.t. trilineata* (Fig. 3, 4). Other apparent differences as seen in the dorsal view outlines are likely not of significance.

An examination of larvae of these species by the senior author has not shown differences that will allow certain separation of the two.

Below is a key that will allow separation of the adults of *L. trivittata* and *L.t. trilineata*.

- 1. Lateral black stripe on elytron at widest encompassing 2-2 1/2 (rarely nearly 3) intervals; tibiae usually black for less than 1/2 length ..... *L. trivittata*
- Lateral black stripe on elytron encompassing 3-4 intervals or wider; tibiae nearly always black for more than 1/2 of length ..... *L.t. trilineata*

Distribution

In the USNM collection there are about 550 specimens of *L.t. trilineata* and about 650 specimens of *L. trivittata* that have been collected from a great number of different localities in the United States. Both occur nearly throughout the United States east of the Mississippi River, and thence diagonally to southwestern United States. Both have been taken in Iowa, Colorado, Utah, and California, but in no western states farther north than these. The species appear to be almost totally sympatric in their distribution.

Biology

In 1967 the junior author worked at Moorestown, New Jersey, and was involved with introduction of parasites of the cereal leaf beetle, *Oulema melanopus* (L.). During attempts to find alternate native hosts for certain of the parasites, a species of *Lema* that was abundant on *Datura* in central New Jersey proved to be a satisfactory alternate host.

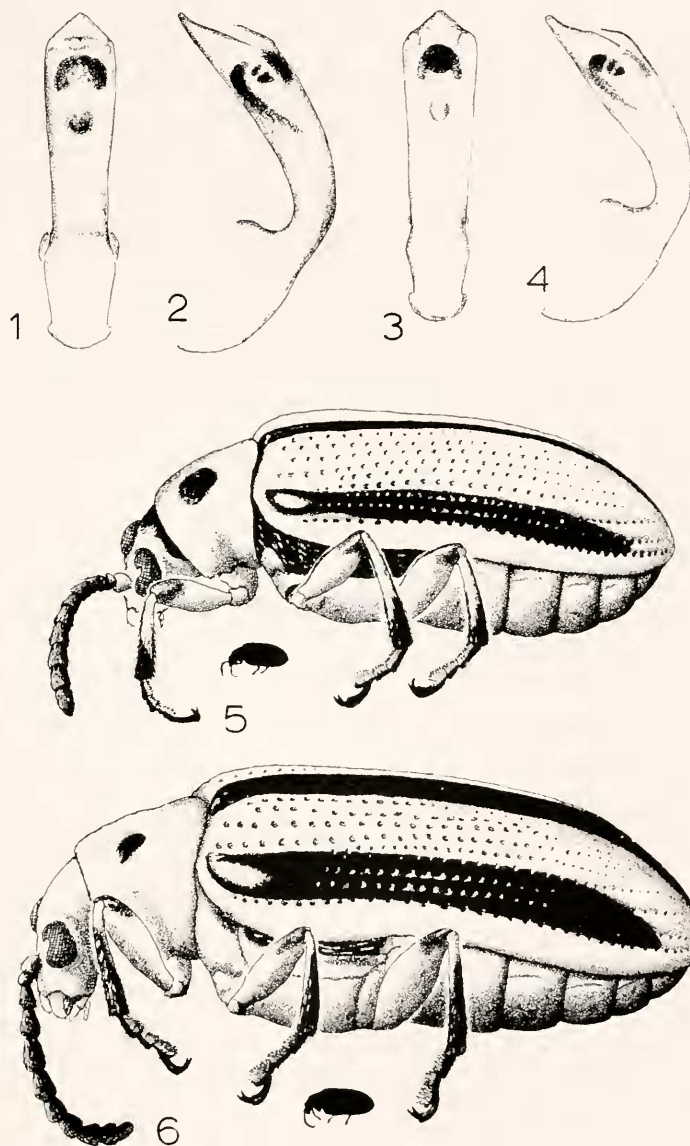


Fig. 1-4, cleared male genitalia: 1. *L. trivittata* Say, dorsal view. 2. *L. trivittata*, lateral view. 3. *L.t. trilineata* (Oliv.), dorsal view. 4. *L.t. trilineata*, lateral view.

Fig. 5-6, adults in lateral view; small figures equal actual size. 5. *L. trivittata*. 6. *L.t. trilineata*.

According to Schaeffer (1933) the *Lema* that was found feeding on *Datura* was a subspecies of *L. trilineata* (Olivier), the threelined potato beetle, a species that was once an important pest of potatoes in the U.S. However, the junior author noted several points of difference between these 2 populations. These observations, especially host plant differences, suggested that the 2 were actually different species. This possibility was tested in the laboratory.

The *Lema* specimens from *Datura* (*L. trivittata*) were maintained on *D. stramonium*, and *L.t. trilineata* was reared on *Solanum Dulcamara* L. Newly emerged females were segregated to prevent mating; 4 (2 from each host) were individually placed in small plastic cages, each with a male from the opposite host plant. During the next 3 weeks while the beetles were supplied with foliage of the 2 host plants, the number of matings was observed and the number of eggs produced was recorded. Confinement of a male with a female lasted from 19 to 22 days. The viability of the eggs was determined by observing them in petri dishes supplied with damp filter paper. The results are shown on Table 2. Numbers (1-8) were assigned to the beetles of each species used in the tests.

After the first confinement period each female was put with a male of its own population. This was to determine if the fertility of the 2 groups of beetles would differ when selfed. At this time the original beetles were nearly 4 weeks old, so the same number of newly emerged beetles (numbers 5-8) were confined so males and females of a population were together, and the results were observed.

When the beetles from the 2 different hosts were crossed (Table 2), few matings and eggs resulted, and all eggs were infertile. Later, when these females were placed with males of the same population, many more eggs were produced by the *L. trivittata* females, and many hatched. There was also moderately good hatching of the eggs produced by the 2 pairs of younger beetles (numbers 5-8). When selfed, the older specimens of *L.t. trilineata* (numbers 1-4) were not active, mated little, and produced no eggs. However, the 2 younger pairs of this species (numbers 5-8) did mate and produce a fair number of eggs, many of which hatched. It is suspected that the lack of reproductive success of *L.t. trilineata* pairs numbered 1-4 was the result of the advanced age of the beetles, or to reproductive diapause.

The results of the mating tests indicate that the 2 populations of beetles are reproductively isolated. This, together with the different hosts, similar distribution patterns, and morphological differences, indicate that they should be regarded as different species.

**Table 1. Color differences, dead specimens of *L. trivittata* and *trilineata*.**

Character	<i>L. trivittata</i>	<i>L. trilineata trilineata</i>
lateral black stripe on elytron	at widest encompassing 2-2 1/2 (rarely nearly 3) intervals, never joins sutural stripe	encompassing 3-4 intervals or wider, may join sutural stripe (dark form)
legs	tibiae usually black for less than 1/2 length; femora sometimes black apically	tibiae nearly always black for more than 1/2 of length; femora usually not black apically
sternal side pieces	often broadly black	sometimes narrowly black
paired black spots on pronotum	large to small, often absent	large to (often) small, infrequently absent
head	often orange throughout, black, when present, usually basal, sometimes around eyes and on labrum-clypeus	often orange throughout, black, when present, usually between eyes, sometimes also basal
ventral surface	coxae and abdomen sometimes (rarely also metasternum) partly black	pale, rarely partly black

**Table 2. Breeding experiments with *L. trivittata* and *L. trilineata*.**

	<i>Lema</i> species		Matings observed	Eggs	Hatched
	Females	Males			
Cross matings	<i>trivittata</i> 1	<i>t. trilineata</i> 3	2	42	0
	<i>trivittata</i> 2	<i>t. trilineata</i> 4	1	0	-
	<i>t. trilineata</i> 1	<i>trivittata</i> 3	4	0	-
	<i>t. trilineata</i> 2	<i>trivittata</i> 4	7	17	0
Self matings	<i>trivittata</i> 1	<i>trivittata</i> 3	3	219	42%
	<i>trivittata</i> 2	<i>trivittata</i> 4	7	576	32%
	<i>trivittata</i> 5	<i>trivittata</i> 7	13	266	32%
	<i>trivittata</i> 6	<i>trivittata</i> 8	4	139	19%
	<i>t. trilineata</i> 1	<i>t. trilineata</i> 3	0	0	-
	<i>t. trilineata</i> 2	<i>t. trilineata</i> 4	2	0	-
	<i>t. trilineata</i> 5	<i>t. trilineata</i> 7	4	29	31%
	<i>t. trilineata</i> 6	<i>t. trilineata</i> 8	5	14	100%

## Collection notes

The numerous adults of these 2 species in the USNM collection frequently bear notes which indicate the plants on which the specimens were collected; these records are given below. Notes of this sort may indicate the actual larval host, a plant on which the adult feeds, or may indicate a plant on which the adult was simply resting. There is always the possibility that errors may have been made in the recording of field notes.

The first 4 records listed below for *L. trivittata* are known larval hosts; the first 6 for *L.t. trilineata* are known larval hosts.

*Lema trivittata*: jimson weed, ex *Datura*, *Datura stramonium* L., on *Datura quercifolia* H.B.K., in cornfield, on strawbrry, on *Physalis*, on *Hyoscyamus*, on *Atropa belladonna* L., wild barley, on sunflower, cotton bud, bred from *Solanum*, on *Chamaesaracha conioides* Britton, wheat, on English pea foliage, on tomato leaves, with string bean leaves, feeding on potato, on Irish potato foliage, on okra leaves, on *Melilotus indica* (L.) All. foliage, with parsley roots and leaves, *Solanum elaeagnifolium* Cav.

*Lema t. trilineata*: *Solanum dulcamara*, on *Physalis alkekengi* L., japanese lantern, reared potato, chinese lantern, on *Physalis*, jimson weed, on corn, on sweet corn, on beans, on *Datura stramonium* L., on *Nicandra physalodes* (L.) Gaertn. (sic), feeding on belladonna.

## LITERATURE CITED

- Balsbaugh, E.U., Jr., and K.L. Hays. 1972. The Leaf Beetles of Alabama (Coleoptera: Chrysomelidae). Auburn Univ. Agric. Exp. Stan. Bull. 441. 223 pp.
- Blackwelder, R.E. 1939. Fourth supplement to the Leng catalogue of Coleoptera of America, North of Mexico. J.D. Sherman: Mount Vernon, N.Y. 146 pp.
- \_\_\_\_\_. 1946. Checklist of the Coleopterous insects of Mexico, Central America the West Indies, and South America. Part 4. U.S. Natl. Mus. Bull. 185. pp. 551-763.
- Brimley, C.S. 1938. The insects of North Carolina. North Carolina Dept. Agric., Raleigh. 560 pp.
- Chevrolat, A. 1835. Coléoptères du Mexique. Strasbourg. Fasc. 5. pp. "101-128".
- Clark, H. 1866. A Catalogue of Phytophaga. [Coleoptera, Pseudotetramera]. Part 1. London. 50 pp.
- Clavareau, H. 1913. Coleopterorum Catalogus. Pars 51: Chrysomelidae: 1. Sagrinae, 2. Donaciinae, 3. Orsodacninae, 4. Criocerinae. Berlin. 103 pp.
- Cockerell, T.D.A., and H.C. Fall. 1907. The Coleoptera of New Mexico. Trans. Am. Entomol. Soc. 33:145-272.
- Crotch, G.R. 1873. Check list of the Coleoptera of America, north of Mexico. Naturalist's Agency, Salem, Mass. 136 pp.
- Emmons, E. 1854. Natural History of New York. Vol. 5. Insects of New York. Albany, 272 pp.
- Fattig, P.W. 1948. The Chrysomelidae or leaf beetles of Georgia. Emory Univ. Mus. Bull. no. 6, pp. 1-47.
- Force, D.C. 1966. Reactions of the three-lined potato beetle, *Lema trilineata* (Coleoptera:

- Chrysomelidae), to its host and certain nonhost plants. *Ann. Entomol. Soc. Am.* 59:1112-9.
- Harris, T.W. 1833. The insects of Massachusetts. Report Geology, Minerals Botany, Zoology: Amherst, Mass. pp. 566-595.
- Jacoby, M. 1880. Family Crioceridae. *In* *Biologia Centrali-Americana, Insecta. Coleoptera.* 6:2-19.
- Jacoby, M., and H. Clavareau. 1904. Coleoptera Phytophaga, Fam. Crioceridae. *In* *Genera Insectorum*, P. Wytzman. Fasc. 23. pp. 1-40.
- Knowlton, G.F., and C.F. Smith. 1935. Notes on Utah Scarabaeidae and Chrysomelidae (Coleoptera). *Entomol. News* 46:241-4.
- Kogan, M. and R.D. Goeden. 1970. The systematic status of *Lema trilineata daturaphila*. New Name, with notes on the morphology of chemoreceptors of adults (Coleoptera: Chrysomelidae). *Ann. Entomol. Soc. Am.* 63:529-37.
- Lacordaire, J.T. 1845. Monographie des Coléoptères subpentameres de la famille des Phytophages. Vol. 1, pt. 1. *Mém. Soc. Roy Sci. Liège* 3:1-740.
- LeConte, J.L. 1859. The Coleoptera of Kansas and eastern New Mexico. *Smithson. Contrib. Knowl.* 2:1-58.
- Leng, C.W. 1920. Catalogue of the Coleoptera of America, North of Mexico. J.D. Sherman: Mt. Vernon, N.Y. 470 pp.
- Löding, H.P. 1945. Catalogue of the beetles of Alabama. *Geol. Surv. Ala. Monog.* 11. 172 pp.
- Monros, F. 1960. Los Generos des Chrysomelidae. *Opera Lilloana*, 3:336 pp.
- Puttler, B. 1966. Notes on two parasites attacking a *Lema* sp. (Coleoptera:Chrysomelidae). *J. Econ. Entomol.* 59:475-6.
- Say, T. 1824. Descriptions of coleopterous insects collected in the late expedition to the Rocky Mountains . . . *J. Acad. Nat. Sci. Phil.* 3:403-62.
- Schaeffer, C. 1933. Short studies in the Chrysomelidae (Coleoptera). *J. N.Y. Entomol. Soc.* 41:297-325.
- Snow, F.H. 1907a. List of Coleoptera collected in New Mexico . . . *Trans. Kans. Acad. Sci.* 20:41-65.
- \_\_\_\_\_. 1907b. List of the Coleoptera collected in New Mexico . . . *Ibid* 20:165-89.

## AWARDS FOR STUDY

The Academy of Natural Sciences of Philadelphia, through its Jessup and McHenry funds, makes available each year a limited number of awards to support students pursuing natural history studies at the Academy. Awards usually include a stipend to defray living expenses, and support for travel to and from the Academy. Current application deadlines are 1 April and 1 October 1980. Further information may be obtained by writing to: Chairman, Jessup-McHenry Award Committee, Academy of Natural Sciences of Philadelphia, 19th and the Parkway, Philadelphia, Pennsylvania 19103.